Evaluating Energy Savings Potential for Deep Well Pump Variable Frequency Drive Installation for the Madison Water Utility

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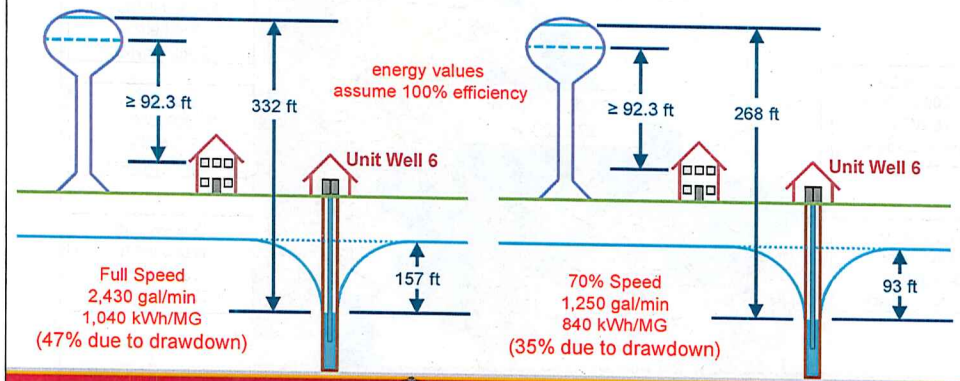
Civil and
Environmental Engineering
UNIVERSITY OF WISCONSIN-MADISON

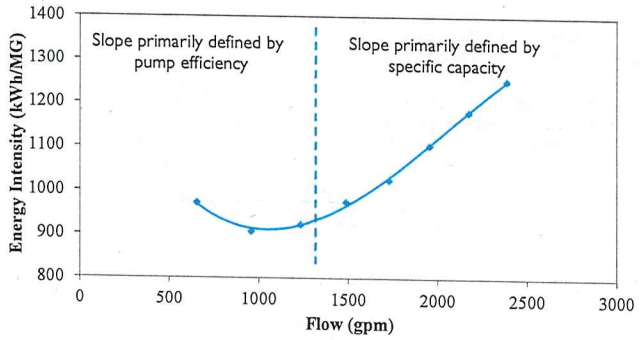
Research Objective

- Determine energy savings potential of VFD installation for existing Madison Water Utility deep well pumps
  - Build on the results of work done by previous graduate students

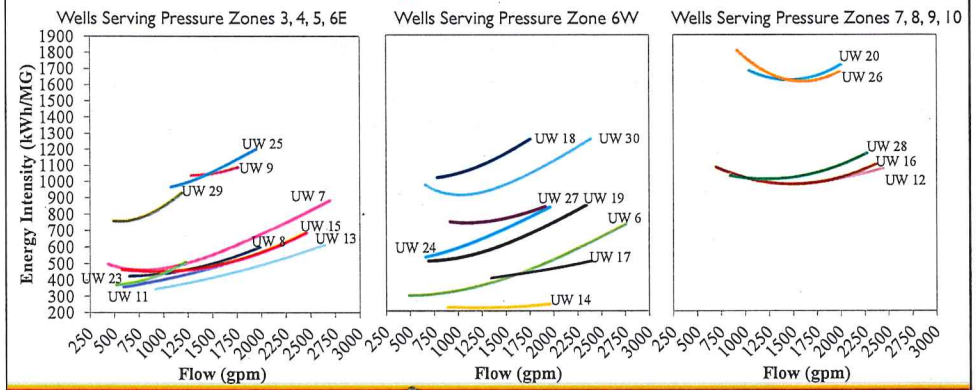
VFD Example: Madison, Wisconsin – Well 6



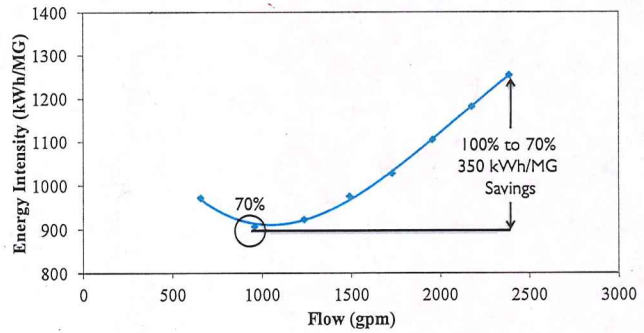
Unit Well 30 Energy Intensity Curve



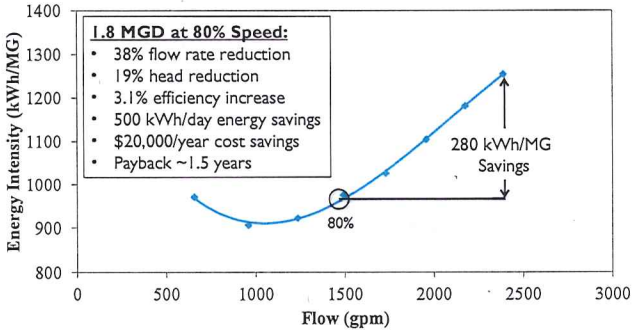
Utility-Wide Results



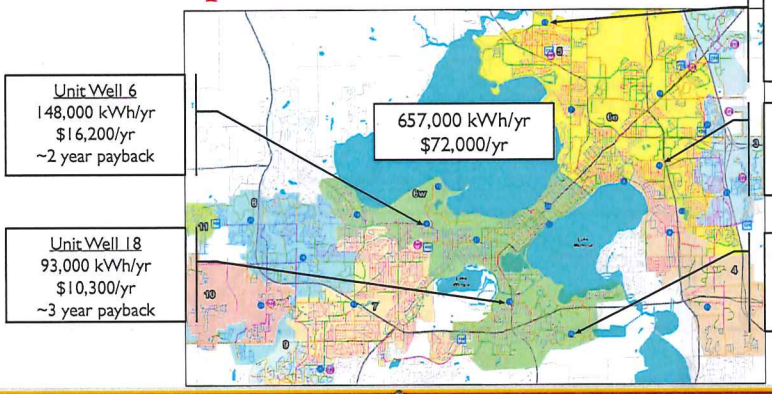
Unit Well 30 Energy Intensity Curve



Unit Well 30 Energy Savings Estimates

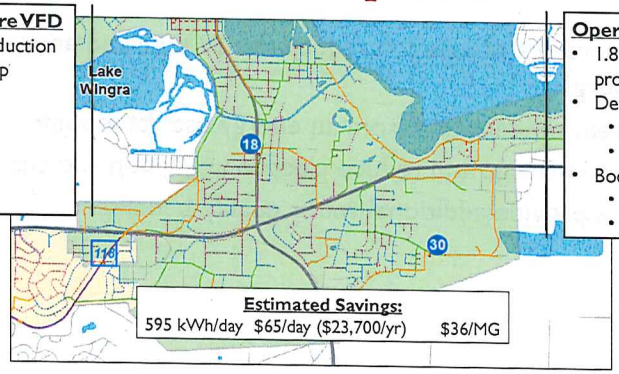


Top Candidates for VFD Installation



Unit Well 30 Operation

Operation Before VFD
- 1.87 MGD production
- Deep well pump
  - 2,410 gpm
  - 13 hrs/day
- Booster pump
  - 1,300 gpm
  - 24 hrs/day



Operation After VFD
- 1.86 MGD production
- Deep well pump
  - 1,450 gpm
  - 21.5 hrs/day
- Booster pump
  - 1,280 gpm
  - 24 hrs/day

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Unit Well 30 Energy Savings

Energy Use Before VFD
- 3,980 kWh/day
- 2,130 kWh/MG
- Operation costs
  - $380/day
  - $207/MG

Energy Use After VFD
- 3,440 kWh/day
- 1,850 kWh/MG
- Operation costs
  - $320/day
  - $170/MG

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Long-term Savings Update

VFD Operation: December 2016 – June 2017

Savings Compared to December 2015 – June 2016
- 277 kWh/MG energy intensity savings
- $25.40/MG savings
- 94,550 kWh saved
- $8,660 saved

Savings Compared to June 2016 – November 2016
- 288 kWh/MG energy intensity savings
- $26.70/MG savings
- 97,940 kWh saved
- $9,090 saved

Expected payback of 1.5 years

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Conclusions

- Deep well pumps have significant potential for energy savings with VFD installation because of the potential to reduce drawdown and head
  - Nearly 100,000 kWh and $9,000 of savings 6 months after VFD installation at Unit Well 30, the top-ranked well in the system.
  - Remaining top candidates for VFD installation are Unit Wells 6, 13, 11, and 18. Estimated yearly savings of 470,000 kWh and $52,000 at these sites.
- Considering only energy savings, VFD installation may not be effective at every well (e.g. Unit Well 14 or Unit Well 26).

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Recommendations

- Continue installing VFDs based on energy savings potential
  - Prioritize VFD installation at Unit Well 6, where expected cost savings >$15,000 per year
- Continue to expand the study of VFD installation to include systems of several wells or entire pressure zones.

Future Research Options

- Continue to pursue strategies to reduce the $2.6 million annual budget for energy
- Research system optimization from an energy use standpoint
- Explore ways to manage and reduce electric utility demand charges
- Identify if VFDs provide additional water quality benefits

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